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(54) Inductive loop sensor

(57) An inductive loop presence detector, more especially a vehicle detector, including a loop oscillator 12 having an inductive loop 11 connected as a frequency determining element of the oscillator, which inductive loop 11 may be buried in a roadway to sense the presence of vehicles, and sensing circuitry 13 to detect changes in the loop oscillator frequency due to vehicle movements in the vicinity of the loop 11, with a filter network 14 inserted between the output of the loop oscillator 12 and the sensing circuitry 13 to improve performance when cross-talk occurs due to mutual interference between a number of inductive loop detectors forming part of a total installation. The filter network 14 can be a phase-locked loop incorporating a low pass filter to attenuate high frequency components due to cross-talk.

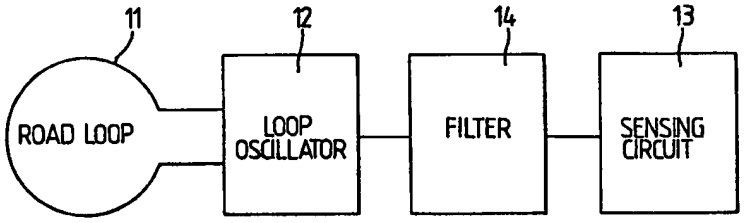

Fig.1.

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The drawing originally filed was informal and the print here reproduced is taken from a later filed formal copy.

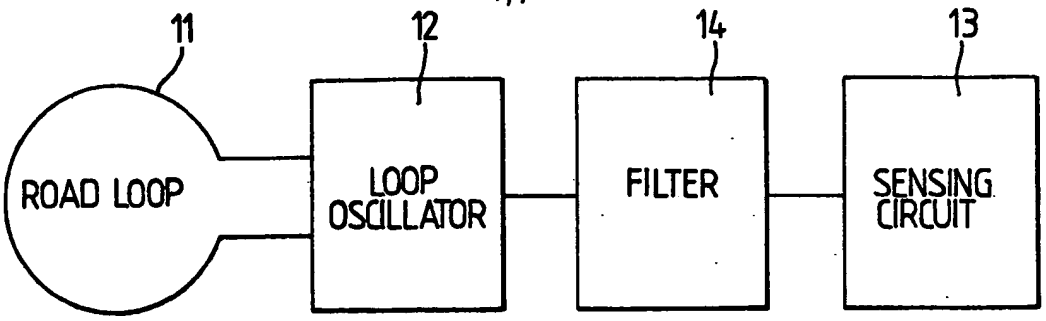

Fig.1.

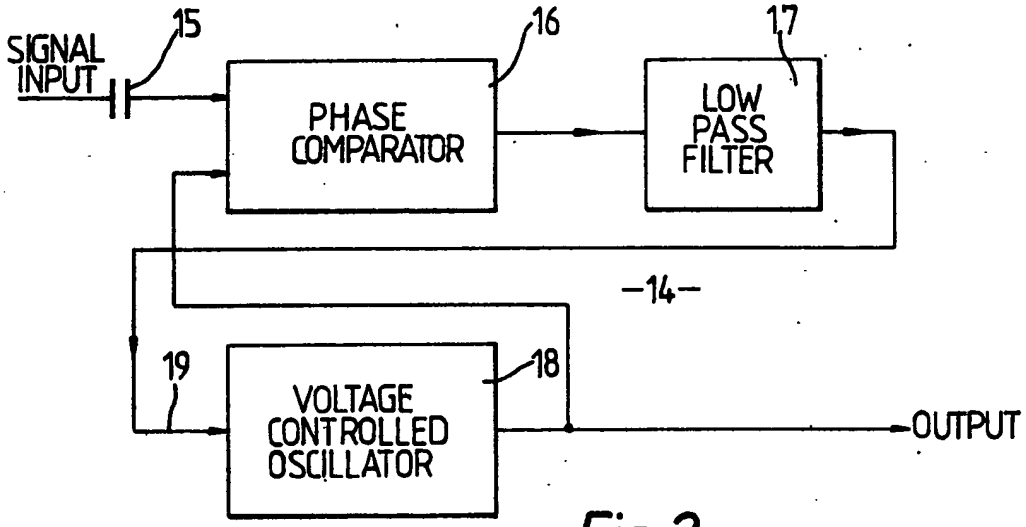

Fig.2.

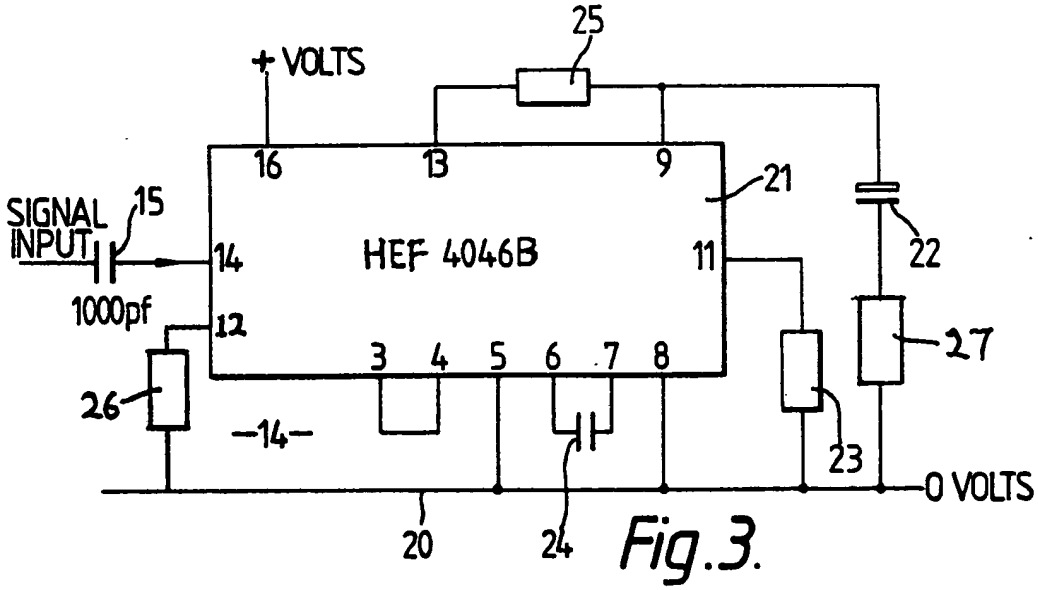

Fig.3.

SPECIFICATION

Improvements in inductive loop presence detectors

This invention relates to inductive loop presence detectors, and more particularly inductive loop installations for detecting the presence of vehicles.

When more than one inductive loop vehicle detector is used on a typical installation the detectors can cause mutual interference between one another commonly called "cross talk". The effect is usually brought about by inductive coupling between the loops laid in the roadway although it can be produced by capacitive coupling.

Each road loop is connected to an oscillator and when "cross talk" occurs frequency sidebands are produced in the oscillator whose amplitude and frequency depend upon the frequency separation between the interfering oscillators. This can disturb the sensing circuitry that follows each oscillator and the purpose of which is normally to identify changes in frequency of the loop oscillator caused by vehicle movements.

According to the present invention there is provided an inductive loop presence detector comprising an inductive loop to sense the presence of an object to be detected, a loop oscillator having said inductive loop connected thereto as an element determining frequency of oscillation, sensing circuitry to detect changes in the loop oscillator frequency due to the movement of an object to be detected in the vicinity of said loop, and a filter network inserted between the loop oscillator output and the input of said sensing circuitry to attenuate "cross talk" due to mutual interference between a plurality of inductive loop detectors.

The filter network is preferably a phase-locked loop.

Apart from dealing with the "cross talk" problem, the filter has the further important advantage that it improves the ability of the detector to reject random noise by reducing the effective bandwidth of the detector.

Arrangements according to the invention will now be described by way of example with reference to the accompanying drawings, in which:—

Figure 1 is a block diagram of a vehicle presence detector embodying the invention;

Figure 2 is a circuit and block diagram of the filter network incorporated in the embodiment of Figure 1 according to the invention, and

Figure 3 shows how the filter network of Figure 2 can be implemented in practice.

Figure 1 shows a vehicle presence detector comprising an inductive loop 11 laid in a roadway, a loop oscillator 12 and a sensing circuit 13 to sense changes in the loop oscillator frequency due to movements of vehicles in the vicinity of the loop. The filter network 14 according to the invention is located between the oscillator 12 and the sensing circuit 13.

Figure 2 shows the filter network 14 in block diagram form. The output of the loop oscillator 12, including the cross talk frequency sidebands, is applied via a capacitor 15 to one input of a phase comparator 16 which receives on its other input the output of a voltage controlled oscillator 18. The output of the comparator 16 is applied via a low pass filter 17 to the frequency control input 19 of the oscillator 18. The voltage controlled oscillator 18 therefore locks to the fundamental frequency of the loop oscillator 12, since the comparator 16 produces a control voltage that regulates the frequency of the oscillator to eliminate any frequency difference at the comparator inputs. The cross talk frequencies produce high frequency components at the comparator output which are attenuated by the low pass filter 17. The output of the filter network 14 is the output of the voltage controlled oscillator 18, which is applied to the input of the sensing circuit 13 of Figure 1.

Figure 3 shows how the filter network of Figure 2 can be implemented using an HEF4046B integrated circuit chip 21 manufactured by Signetics. The input signal via capacitor 15 is applied to pin No. 14 and a positive supply voltage is applied to pin No. 16. Pins Nos. 5 and 8 are connected directly to the zero volts line 20, while pins Nos. 9, 11 and 12 are connected to the zero volts line via a capacitor 22 and resistor 27, a resistor 23, and a resistor 26, respectively. Pins Nos. 3 and 4 are connected directly together, pins Nos. 6 and 7 are connected via a capacitor 24, and pins Nos. 9 and 13 are connected via a resistor 25.

CLAIMS

1. An inductive loop presence detector, comprising an inductive loop to sense the presence of an object to be detected, a loop oscillator having said inductive loop connected thereto as an element determining frequency of oscillation, sensing circuitry to detect changes in the loop oscillator frequency due to the movement of an object to be detected in the vicinity of said loop, and a filter network inserted between the loop oscillator ouput and the input of said sensing circuitry to attenuate cross talk due to mutual interference between a plurality of inductive loop detectors.

2. A detector according to Claim 1, wherein said filter network is a phase-locked loop including a low pass filter to attenuate high frequency components due to cross-talk.

3. A detector according to Claim 1, wherein said filter network comprises an input capacitor receiving the output of said loop oscillator, a voltage controlled oscillator, a phase comparator receiving the signal from said input capacitor on a first input and the output of said voltage controlled oscillator on a second input, and a low pass filter receiving on its input the output of said phase comparator and delivering its output as a control voltage to a control input of said voltage controlled oscillator, whereby the frequency of said voltage controlled oscillator is locked to that

of said loop oscillator, and said low pass filter attenuates cross talk.

4. An inductive loop vehicle detector, substantially as described with reference to the accompanying drawings.

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